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REVISITING THE ROLE OF BAD NEWS IN MAINTAINING HUMAN OBSERVING BEHAVIOR

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Results from studies of observing responses have suggested that stimuli maintain observing owing to their special relationship to primary reinforcement (the conditioned-reinforcement hypothesis), and not because they predict the availability and nonavailability of reinforcement (the information hypothesis). The present article first reviews a study that challenges that conclusion and then reports a series of five brief experiments that provide further support for the conditioned-reinforcement view. In Experiments 1 through 3, participants preferred occasional good news (a stimulus correlated with reinforcement) or no news (a stimulus uncorrelated with reinforcement) to occasional bad news (a stimulus negatively correlated with reinforcement). In Experiment 4 bad news was preferred to no news when the absence of stimulus change following a response to the bad-news option was reliably associated with good news. When this association was weakened in Experiment 5 the results were intermediate. The results support the conclusion that information is reinforcing only when it is positive or useful. As required by the conditioned-reinforcement hypothesis, useless information does not maintain observing.

Key words: observing behavior, conditioned reinforcement, information, discriminative stimuli, delay-reduction theory, choice, humans

Observing responses are those which produce stimuli correlated with schedules of reinforcement, but that have no effect on the occurrence of reinforcement (Wyckoff, 1952). For example, two equally probable schedules of reinforcement differing only in frequency of reinforcement—say, variable time (VT) and extinction (EXT)—may alternate unpredictably. Effective observing responses would produce stimuli identifying the schedule in effect.

The study of observing responses has been deemed central to an understanding of the basis for conditioned reinforcement. Does a stimulus function as a conditioned reinforcer (and therefore maintain observing responses) because it is correlated with the occurrence of primary reinforcement (the ''conditioned-reinforcement hypothesis'')? For example, according to delay-reduction theory (e.g., Fantino, 1969) a stimulus will be a conditioned reinforcer when its onset is correlated with a reduction in time to primary reinforcement. This prediction is also consistent with other major theories of conditioned reinforcement, e.g., the hyperbolic value-added model of Mazur (2001). Alternatively, does a stimulus function as a conditioned reinforcer (and therefore maintain observing responses) because it predicts or informs about the availability of reinforcement (the ''information'' or ''uncertainty-reduction hypothesis'')? As Bloomfield (1972) argued, the critical test for distinguishing between these views is whether or not an S-, or bad news, is reinforcing. The overwhelming preponderance of evidence shows that it is not (e.g., see Dinsmoor, 1983; Fantino & Case, 1983), a result more consistent with the conditioned-reinforcement hypothesis.

This conclusion was challenged in a thoughtful review and set of experiments by Lieberman, Cathro, Nichol and Watson (1997). They argued that the case for the conditioned-reinforcement hypothesis was unproven where humans were concerned. With a resurgence of

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interest in observing-response experiments (e.g., DeFulio & Hackenberg, 2008; Fantino, 2008; Pessoa, Huziwara, Perez, Endemann, & Tomanari, 2009; Shahan & Podlesnik, 2005; 2008; Tomanari, 2004), it would appear to be a good time to assess the alternative account given by Lieberman et al. Toward this end, we review and evaluate their argument and results, and then present some new data that would appear to support the conditioned-reinforcement hypothesis in humans.

Lieberman et al. (1997) acknowledge that several studies have supported the conclusion that ''no news'' (presentation of a stimulus that is not predictive of reinforcement) is preferred to ''bad news'' with human participants, including children. They note: ''On the surface … results strongly supported the view that a stimulus must be paired with a primary reinforcer in order to become a secondary reinforcer'' (Lieberman et al., p. 23). However, they caution that participants' apparent preference for ''no news'' might have been maintained by a form of ''superstition'' involving the erroneous belief that responses on the no-news button actually increased the probability of reinforcement. Specifically they note: ''The wording of the instructions could have inadvertently encouraged participants to believe that observing responses would influence the delivery of points'' (p. 24). Lieberman et al. then go on to conduct three experiments, the results of which may be taken to support their interpretation in terms of the information hypothesis of observing.

In the first experiment, they created a scenario and instructions that they felt would minimize the likelihood of superstition. They obtained a clear preference for bad news (that is, the stimulus reliably correlated with EXT) over no news (a stimulus uncorrelated with the schedule in effect), thereby supporting the information hypothesis of observing. However, observing responses in this experiment were always effective (a continuous reinforcement or fixed-ratio 1 [FR 1] schedule of observing). They acknowledged that since the University of California, San Diego (UCSD) studies used variable-interval (VI) schedules of observing (Case, Fantino, & Wixted, 1985; Fantino & Case, 1983; Fantino, Case, & Altus, 1983), this difference and not superstition might account for the stark difference in the results. Thus, they conducted a second experiment with two groups of participants. For one group, observing was available on FR 1; for the other on a VI schedule. They replicated the clear preference for bad news in the FR-1 participants, but found indifference for participants in the VI-schedule group. This latter result would appear to be incompatible with the information hypothesis.

Lieberman et al. (1997) argued that the indifference might reflect ''boredom'' on the part of the participants. With most observing responses ineffective, participants might become bored, leading them to respond randomly and therefore appear to be indifferent. In order to assess this possibility Lieberman and colleagues conducted a third experiment in which participants were given only a small number of observing responses (30), and were required to pay for any additional observing responses (''VI Cost'' condition). Lieberman et al. conjectured that the cost contingency should eliminate responses made out of boredom and therefore reveal true preference for no news or bad news. In fact, the results of this last experiment supported their conjecture: Whereas participants were again indifferent in a replication of the VI condition (without cost), a strong preference for bad news over no news was evident in the VI-Cost condition.

While this interpretation and the supporting results would appear to pose a problem for the conditioned-reinforcement hypothesis, closer inspection suggests otherwise. First of all, the superstition argument does not appear to explain any of the differences found in Lieberman et al.'s (1997) own results, much less the consistent results favoring no news over bad news in the UCSD studies. More importantly, participants in the UCSD studies were given a 10-min trial run with the observing procedure and then given a questionnaire in order to assess the participants' understanding of the function of responding and of the relation of the lights to earning points. As noted in Case et al., (1985): ''Answers to the questions were immediately evaluated. If a question was answered erroneously, the participant was carefully corrected before proceeding with the full session. After the full session, the same questions…were asked'' (Case et al., p.293). In fact, very few errors were made.

We reviewed the questionnaire data reported in three early UCSD studies (Case et al., 1985; Fantino & Case, 1983; Fantino et al.,

1983). In Fantino et al., no errors were made. In the other two studies 4% of the items were answered incorrectly. There was no indication that participants who made errors (and therefore were possible candidates for a superstition interpretation) were more likely to prefer no news to bad news. In fact, the only participant in either study to show a preference for bad news (participant #1 in Experiment 3 of Fantino & Case) was one who had made errors. Even assuming that all of the errors reflected belief that the stimulus associated with no news made the earning of points more likely (the superstition argument), it should be noted that participants were corrected after the few errors that did occur. In order to plausibly maintain the superstition argument, it would appear necessary to conclude that most participants in the study were lying to the experimenter.

We should note, however, that the reports of participants in the Lieberman et al. (1997) studies almost uniformly cited the informativeness of the stimuli as a basis for their choices. We cannot account for the reported differences in the verbal reports of the participants from Stirling and from UCSD, except to speculate that our questionnaire and correction procedure might have played a role in the different verbal reports.

If we have rendered the superstition argument implausible, how do we account for the marked difference in the results from the UCSD studies and those of Lieberman and colleagues? There is no difficulty accounting for the preference for bad news found by Lieberman et al.'s (1997) group when observing was available on FR 1. Assuming that points were equiprobable with respect to selection of the no-news and bad-news options, then any response on the bad-news option that did not produce the S- was positively correlated with S+. Therefore, good news was likely maintaining observing on the ''bad news'' option and thus the ostensible preference for bad news over no news. It should be noted, however, that participants in the Lieberman studies did not report that ''no message meant that they were more likely to have been in the Point condition'' (p. 40). The same explanation applies to the VI-Cost condition. With just 30 free responses, participants' responding was extremely low, approximating that in the FR-1 conditions. Again, a response on the bad-news option that did not produce bad news was correlated with good news. This correlation would not be in effect in the VI condition, assuming a sufficiently high rate of observing responding, and no preference for bad news over no news occurred there. Thus, there is no necessity to assume that participants' boredom drove the results. Moreover, it is not clear how an explanation in terms of boredom can explain why the boredom-driven responses should be equally apportioned to the two options, nor how it can account for the large preferences for no news over bad news consistently found in the UCSD studies.

An ostensibly puzzling aspect of the Lieberman et al. (1997) studies (Experiments 2 and 3) is the lack of preference for no news in the VI condition. However, the same general explanation in terms of implicit good news may account for the lack of a preference for no news over good news even in these conditions. If response rates on the VI were sufficiently low, there would remain a correlation between responses on the bad- news option and good news that would have countered the kind of large preference for no news over bad news reported in the UCSD studies. Unfortunately, Lieberman et al. do not report response rates. However, they do note that the response rates reported in Fantino and Case (1983) were so high as to be ''puzzling'' (Lieberman et al., p. 23), perhaps suggesting that response rates in their own VI schedules were lower. Also, they note ''subjects in the VI group sometimes paused for periods longer than 1 min'' (p. 36).

In summary then, the conditioned-reinforcement hypothesis of observing does not appear to be seriously compromised by the arguments or data of Lieberman et al. (1997). The present set of brief experiments assesses whether or not we can replicate these results using a procedure which differs in two principal ways: (1) the instructions are more straightforward, i.e., simpler; (2) we vary the degree of implicit good news available for responding on the bad-news option. Thus, in Experiments 2 and 3 there is virtually no such correlation; in Experiment 4, responses on the bad-news option are uniquely correlated with good news when no stimulus change is produced (correlation = 1.0); and in Experiment 5, the correlation is present but weaker. If our analysis is correct, we expect: (1) preference for no news over bad news should

occur in Experiments 2 and 3; (2) preference for bad news over no news in Experiments 4 and 5; and (3) a stronger bad- news preference in Experiment 4 than in Experiment 5. In each experiment, participants were studied in two sessions. Data from both sessions are presented, but results and statistical analyses focus on results from the second sessions only. Finally, none of the participants in these experiments took part in more than one of the experiments.

EXPERIMENT 1

We first offered the simple choice of good versus bad news. While both options are equally informative, the conditioned-reinforcement hypothesis requires preference for good news. Nor, to our knowledge, has any proponent of the information view regarded such a preference as damaging. But this manipulation permitted us to assess the feasibility of our procedure.

Method

Participants

Four female American University undergraduates served as participants in exchange for receiving extra credit in an introductory-level psychology course.

Experimental Setting

The experiment was conducted in a dimly illuminated office. In the office were two chairs and a desk. On the desk was an IBM-compatible computer with a 43-cm diagonal monitor and a separate mouse.

Procedure

Once the participant was seated, the experimenter started a computer program written in Microsoft Visual Basic 6 that presented an 18.5-cm wide by 14-cm high gray rectangle on the monitor. Three 2.5-cm squares were horizontally arrayed 1 cm below the top edge of this rectangle. The middle square, which was used to project images, was centered between the rectangle's sides (*image box*). The side squares, which served as loci for mouse clicks (*response boxes*), were positioned 4.3 cm laterally from the center of the image box, distances measured center-to-center. Directly below the image box was a 0.8-cm high by 2.5-cm wide rectangle with a white background. The upper edge of this rectangle, which served as a counter (*counter box*), was 2.3 cm below the lower edge of the image box.

Text was present on the surface of each response box. The first box (*good-news response box*) stated: ''If response here produces pattern between keys, reward is coming.'' The second box (*bad-news response box*) stated: ''If response here produces pattern between keys, reward is not coming.'' Text immediately above the image box stated: ''Informative pattern sometimes presented below after side-key responses.'' Finally, above the counter box it said: ''Nickels Earned.''

Prior to beginning, the experimenter read aloud a script presented on the computer monitor. The participant could read the text as well. It stated:

> In this experiment you have the chance to occasionally earn a point which is worth a nickel. The number of nickels earned will be shown in the following box (experimenter points to counter box on screen). The sum earned will be paid at the end of today's session. Also on the screen are two keys to which you can respond (experimenter points to response boxes). One key, when pressed by a mouse click, will sometimes present a stimulus pattern that means that a nickel is soon coming. The other key will sometimes produce a different stimulus pattern which means that a nickel is not coming soon.
>
> While the keys you press will inform you whether or not a nickel is likely to be paid soon, these presses have no effect upon your earnings. In fact, your earnings will be the same even if you do not respond to either key. Moreover, while the pattern between keys can inform you whether a nickel is likely soon or not, often responses to the keys will provide you with no information at all.
>
> So, responses to one key will sometimes tell you a nickel is coming soon, but does not always report that fact. Responses to the other key will sometimes tell you that a nickel is not coming soon, but does not always report that fact.
>
> Do you have any questions?

After questions were answered, the computer program was started. The participant was exposed to a mixed VT 30-s EXT schedule. Whenever the VT schedule made an assignment, the count in the counter box was incremented by one and a 0.5-s tone sounded.

Table 1

For each participant in each session of Experiment 1: responses to the good-news and bad-news response boxes (rows 1 and 2, respectively); the number of good- and bad-news responses that produced an image in the image box (rows 3 and 4, respectively); and the number of good- and bad-news responses that failed to produce an image (rows 5 and 6, respectively). Relative good-news response rate is presented for each subject and the mean (M) across subjects at the bottom of each session's raw-data array.

Session 1:	Participant 1	Participant 2	Participant 3	Participant 4
1. good-news responses	2418	722	82	457
2. bad-news responses	644	198	36	401
3. good-news hits	19	20	15	18
4. bad-news hits	20	19	14	19
5. good-news misses	13	14	8	12
6. bad-news misses	13	12	8	13
Good-news choice proportion:	.79	.64	.69	.53 (M = .66)
Session 2:	**Participant 1**	**Participant 2**	**Participant 3**	**Participant 4**
1. good-news responses	2311	1928	87	594
2. bad-news responses	1083	397	68	130
3. good-news hits	13	24	14	19
4. good-news misses	23	14	11	19
5. bad-news hits	16	19	12	9
6. bad-news misses	12	11	10	8
Good-news choice proportion:	.68	.83	.56	.82 (M = .72)

The order of components was random with the constraint that over 12 successive components, 6 were of the VT schedule and 6 were of EXT. A separate VT 30-s schedule controlled component duration. The intervals of both VT schedules were defined by the Fleshler-Hoffman progression (Fleshler & Hoffman, 1962).

The availability of an image-box pattern was determined by two VI 30-s schedules, one associated with each response box. When a mouse click occurred following a schedule assignment to a response box, a visual pattern appeared for 1 s in the image box if the response-box type matched the ongoing mixed-schedule component. For example, if a response to the good-news box was scheduled to deliver an image to the image box, that image only appeared if the VT component of the mixed schedule was operative (*good-news hit*). If, instead, the EXT component was operating, the image-box assignment was removed and the good-news, response-box VI schedule was started anew (*good-news miss*). Similarly, assignments to the bad-news response box presented an image in the image box if the EXT component of the mixed schedule was in operation *(bad-news hit*), but not if the VT component was operating (*bad-news miss*). For both response boxes, the pattern was a winding thick line. Image-box patterns differed between response boxes only in that one was gray and the other, tan. The position of each response box (left or right) and the color of its image-box pattern (tan or gray) were counterbalanced across participants.

The first session ended after completion of the VT component associated with receipt of the 24th reinforcer. After a 5-min rest period, a second session was conducted. Following that session, the participant was debriefed, paid $2.40 (24 nickels/session X 2 sessions), and thanked for her participation.

Results and Discussion

Table 1 presents the results for each participant. Focusing on results from the second session, it is apparent by comparing rows 1 and 2 that participants responded more to the good-news response box than to the bad-news response box. This result obtained across a wide range of response rates, and whether the number of bad-news stimulus presentations exceeded that of good-news presentations (Participant 1) or not (Participants 2-4).

EXPERIMENT 2

This study assessed the important comparison of no news versus bad news. Here the two hypotheses make more definitively different predictions: bad news should be preferred

according to the information view (since it is the only informative outcome), but not according to the conditioned-reinforcement hypothesis.

Method

Participants

Five American University undergraduates, 3 female and 2 male, served as participants in exchange for receiving extra credit in an introductory-level psychology course.

Experimental Setting

The experimental setting was the same as in Experiment 1.

Procedure

The computer program differed from that used in Experiment 1 in two ways. First, the good-news response box was made into a ''no news'' response box by changing its label from ''If response here produces pattern between keys, reward is coming'' to ''If response here produces pattern between keys, reward is coming or reward is not coming.'' Second, the VI schedule that had been associated with the good-news response box would now make an image-box presentation whether the mixed schedule was in a VT component or an EXT component. In other regards, the program was unchanged from Experiment 1.

The script read to each participant is presented below. The sections of text that were changed from the script in the prior experiment are presented in a bold font.

> In this experiment you have the chance to occasionally earn a point which is worth a nickel. The number of nickels earned will be shown in the following box (experimenter points to reinforcer counter on screen). The sum earned will be paid at the end of today's session. Also on the screen are two keys to which you can respond (experimenter points to keys). One key (left or right, depending upon the participant), when pressed by a mouse click, will sometimes present a stimulus pattern. **This pattern means either that a nickel is coming soon or that a nickel is not coming soon.** The other key will sometimes produce a different stimulus pattern. **Unlike the other key, this pattern means only that a nickel is not coming soon.**
> The keys you press will have no effect upon your earnings. In fact, your earnings will be the same even if you do not respond to either key. Moreover, while the pattern between keys may provide information about how soon a nickel will be given, often responses to the keys will provide you with no stimulus pattern at all. **So, responses to one key will sometimes tell you a nickel is coming soon or not coming soon, but does not always report that fact.** Responses to the other key will sometimes tell you that a nickel is not coming soon, but does not always report that fact.
> Do you have any questions?

In other regards, the procedure was unaltered from that in Experiment 1.

Results and Discussion

A male participant refused to respond during the first session. He explained that since responding had no effect on earnings, he saw no reason to respond. He was paid $2.40, given course credit and removed from the experiment. The results presented are based on the 4 remaining participants.

Table 2 presents the results of Experiment 2. Based on the second session's data, it appears the change of Experiment 1's good-news response box into a no-news response box had no discernible effect on preference. Indeed, the preference that had been evident to the formerly good-news response box remained evident following its transformation to a no-news response box. Three aspects of the data are ostensibly puzzling. First, why is there any responding to the bad-news option? Second, why is there responding to the no-news option? Third, why weren't higher preferences found in Experiment 1 (good news over bad news) than in Experiment 2 (no news over bad news)?

The first question may be addressed by noting that studies of observing with both pigeons and humans have typically reported substantial responding to the bad-news option, generally attributed to sensory reinforcement. Indeed Wyckoff (1952) included a control for sensory reinforcement. An alternative interpretation, of course, would be that observing is maintained by the informative value of the bad news. This interpretation is weakened, however, by the fact that uninformative no-news options are typically strongly preferred to informative bad-news options, as was the case in the present Experiment 2. Sensory reinforcement may, in part, also account for some responding to the no-news option (the second question). In addition, results from a number of studies cited in the Introduction suggest

Table 2

For each participant in each session of Experiment 2: responses to the no-news (row 1) and bad-news (row 2) responses boxes; the number of no-news and bad-news responses that produced an image in the image box (rows 3 and 4, respectively); and the number of bad-news responses that failed to produce an image (row 5). Relative no-news response rate is presented for each subject and the mean (M) across subjects at the bottom of each session's raw-data array.

Session 1:	Participant 5	Participant 6	Participant 7	Participant 8
1. no-news responses	743	161	439	608
2. bad-news responses	119	318	113	332
3. no-news hits	23	13	30	30
4. bad-news hits	18	10	26	21
5. bad-news misses	8	15	8	5
No-news choice proportion:	.86	.34	.8	.65 (M = .66)
Session 2:	**Participant 5**	**Participant 6**	**Participant 7**	**Participant 8**
1. no-news responses	2009	215	867	113
2. bad-news responses	1	202	477	34
3. no-news hits	21	29	41	26
4. bad-news hits	0	11	15	15
5. bad-news misses	0	17	14	8
No-news choice proportion:	1.0	.52	.65	.77 (M = .74)

Note. The row-3 designation of ''no-news hits'' without a row for ''no-news misses'' reflects the fact that the no-news response box's VI 30-s schedule presented a stimulus for a response whether the mixed schedule in effect was VT or EXT.

that relative to bad news, ''no news is good news''. We would have expected higher preferences in Experiment 1 than in Experiment 2 (the third question). One procedural feature that may have enhanced preference for no news in Experiment 2 is the fact that there was more sensory reinforcement available on the no-news option than on the bad-news option. This was corrected in Experiment 3.

EXPERIMENT 3

We repeated Experiment 2 with two modifications. First, we required a minimum rate of responding in view of the one participant who did not respond at all in Experiment 2. We also reduced by half the number of stimulus presentations on the no-news option so that it equaled the number on the bad-news option to control for sensory reinforcement.

Method

Participants

Four American University undergraduates, 2 female and 2 male, served as participants in exchange for receiving extra credit in an introductory-level psychology course. In addition, a female high-school junior was recruited. She did not receive course credit for her participation.

Experimental Setting

The experimental setting was the same as in Experiment 1.

Procedure

The computer program differed from that used in Experiment 2 in that each assignment from the VI schedule associated with the no-news response box interrogated a probability gate set at .5. In consequence, the frequency with which a no-news response produced a stimulus in the image box was cut approximately in half. In other regards, the program was unchanged from Experiment 2.

Because one participant in Experiment 2 did not respond, the script was altered to encourage responding at moderate rates from participants. The script is presented below with the changed text in bold font.

> In this experiment you have the chance to occasionally earn a point which is worth a nickel. The number of nickels earned will be shown in the following box (experimenter points to reinforcer counter on screen). The sum earned will be paid at the end of today's session. Also on the screen are two keys to which you can respond (experimenter points to keys). One key (left or right, depending upon the participant), when pressed by a mouse click, will sometimes present a stimulus

Table 3

For each participant in each session of Experiment 3: responses to the no-news (row 1) and bad-news (row 2) responses boxes; the number of no-news and bad-news responses that produced an image in the image box (rows 3 and 4, respectively); and the number of bad-news responses that failed to produce an image (row 5). Relative no-news response rate is presented for each subject and the mean (M) across subjects at the bottom of each session's raw-data array.

Session 1:	Participant 9	Participant 10	Participant 11	Participant 12	Participant 13
1. no-news responses	1291	280	5926	504	132
2. bad-news responses	590	211	56	513	137
3. no-news hits	16	18	23	19	15
4. bad-news hits	16	14	1	16	16
5. bad-news misses	13	12	0	16	15
No-news choice proportion:	.69	.57	.99	.5	.48 (M = .65)
Session 2:	**Participant 9**	**Participant 10**	**Participant 11**	**Participant 12**	**Participant 13**
1. no-news responses	1206	637	6694	354	1466
2. bad-news responses	739	277	0	879	695
3. no-news hits	16	20	23	7	16
4. bad-news hits	17	11	0	14	20
5. bad-news misses	13	14	0	24	10
No-news choice proportion:	.62	.70	1.0	.29	.68 (M = .66)

Note. The row 3 designation of ''no-news hits'' without a row for ''no-news misses'' reflects the fact that the no-news response box's VI 30-s schedule presented a stimulus whether the mixed schedule in effect was VT or EXT.

pattern. This pattern means either that a nickel is coming soon or that a nickel is not coming soon. The other key will sometimes produce a different stimulus pattern. Unlike the other key, this pattern means only that a nickel is not coming soon.

The keys you press will have no effect upon your earnings. In fact, your earnings will be the same even if you do not respond to either key. Moreover, while the pattern between keys may provide information about how soon a nickel will be given, often responses to the keys will provide you with no stimulus pattern at all. **While the money you earn is not dependent on responding, you are nevertheless asked to respond at a rate of approximately twenty responses per minute (experimenter simulates this rate with the mouse).**

So, responses to one key will sometimes tell you a nickel is coming soon or not coming soon, but does not always report that fact. Responses to the other key will sometimes tell you that a nickel is not coming soon, but does not always report that fact.

Do you have any questions?

In other regards, the procedure was unaltered from that of Experiment 2.

Results and Discussion

Table 3 presents the results from Experiment 3. Looking at the second-session data, all participants except Participant 12 replicate Experiment 2 in showing a preference for the no-news response box to the bad-news response box. Moreover, this result obtained even though the number of number of image-box presentations produced by no-news responding was substantially reduced from levels seen in Experiment 2, and, except for Participant 11, roughly approximated the number of image-box presentations produced by bad-news responding.

EXPERIMENT 4

If our argument is correct that the preference for bad news over no news found by Lieberman et al. (1997) was due to the good news being correlated with the absence of stimulus change on the bad-news option, then we should be able to reverse the preferences we had obtained for no news by making every observing response effective. Thus, observing was arranged on FR 1 schedules as described below.

Method

Participants

Four American University undergraduates, 3 female and 1 male, served as participants in exchange for receiving extra credit in an introductory-level psychology course. In addi-

Table 4

For each participant in each session of Experiment 4: responses to the no-news (row 1) and bad-news (row 2) responses boxes. Relative no-news response rate is presented for each subject and the mean (M) across subjects at the bottom of each session's raw-data array.

Session 1:	Participant 14	Participant 15	Participant 16	Participant 17	Participant 18
1. no-news responses	195	lost	327	119	1177
2. bad-news responses	326	data	536	999	2500
No-news choice proportion:	.37		.38	.11	.32 (M = .3)
Session 2:	**Participant 14**	**Participant 15**	**Participant 16**	**Participant 17**	**Participant 18**
1. no-news responses	170	241	25	37	0
2. bad-news responses	296	753	916	1006	794
No-news choice proportion:	.36	.24	.03	.04	.0 (M = .13)

Note. Due to experimenter error, Participant 15's first-session performances were lost.

tion, a male high-school junior was recruited who received no course credit for his participation.

Experimental Setting

The experimental setting was the same as in Experiment 1.

Procedure

The computer program differed from that used in Experiment 3 in that each response to the no-news response box produced an image-box stimulus. In addition, each response to the bad-news box produced a bad-news stimulus if and only if the EXT component of the mixed schedule was operative. In other regards, the program was unchanged from Experiment 3.

The script was altered to reflect the fact that every response to the no-news response box produced a stimulus. The changed text is presented below in bold font.

> In this experiment you have the chance to occasionally earn a point which is worth a nickel. The number of nickels earned will be shown in the following box (experimenter points to reinforcer counter on screen). The sum earned will be paid at the end of today's session. Also on the screen are two keys to which you can respond (experimenter points to keys). **One key (left or right, depending upon the participant), when pressed by a mouse click, will present a stimulus pattern.** This pattern means either that a nickel is coming soon or that a nickel is not coming soon. The other key will sometimes produce a different stimulus pattern. Unlike the other key, this pattern means only that a nickel is not coming soon.
>
> The keys you press will have no effect upon your earnings. In fact, your earnings will be the same even if you do not respond to either key. Moreover, while the pattern between keys may provide information about how soon a nickel will be given, often responses to the keys will provide you with no stimulus pattern at all. While the money you earn is not dependent on responding, you are nevertheless asked to respond at a rate of approximately twenty responses per minute (experimenter simulates this rate with the mouse).
>
> **So, responses to one key will tell you a nickel is coming soon or not coming soon.** Responses to the other key will sometimes tell you that a nickel is not coming soon, but does not always report that fact.
>
> Do you have any questions?

In all other regards, the procedure was identical to that in Experiment 3.

Results and Discussion

Table 4 presents the results from Experiment 4. As is apparent from the second-session data in the table, participants preferred the bad-news response box that occasionally presented an image-box stimulus predictive of a period of extinction over a no-news response box that provided, on a continuous-reinforcement basis, a stimulus that was of no predictive value regarding the imminence of reinforcement. Thus, we succeeded in reversing the obtained preference, consistent with our interpretation of the Lieberman et al. (1997) results. Comparing the choice proportions from the participants in Experiment 3 (mean preference for no-news of .66) with those from the participants of Experiment 4 (mean preference of .13 for no-news) we found a

statistically significant difference, $t(8) = 3.93$, $p = .002$.

EXPERIMENT 5

If we now weakened the correlation between the absence of stimulus change on the bad-news option and implicit good news we should also weaken the preference for bad news. In other words, in Experiment 4 a response to the bad-news option that produced no stimulus change was perfectly correlated with good news and the bad-news option was strongly preferred to the no-news option. If the correlation on the bad-news option between the absence of stimulus change and good news were weakened then preference for the bad-news option should also be weakened. Experiment 5 explored this possibility by arranging the contingencies so that good news was provided for only one-fourth of responses on the bad-news option.

Method

Participants

Seven American University undergraduates, 5 female and 2 male, served as participants in exchange for receiving extra credit in an introductory-level psychology course.

Experimental Setting

The experimental setting was the same as in Experiment 1.

Procedure

The computer program differed from that used in Experiment 4 in that during the presence of the extinction component of the mixed VT EXT schedule, with $p = .5$, the first response to the bad-news response box produced a gray, winding line in the image box. All subsequent responses during that component were also in the presence of this image. For the other half of occasions when the first bad-news response box occurred during a new EXT component, a blank, white image was presented in the image box. All subsequent responses to the bad-news response box continued in the presence of this image.

The blank, white image also appeared with $p = .5$ when the VT component was operative in the mixed schedule. As had been the case during the EXT component, subsequent VT-component responses were in the presence of the blank, white image as long as that VT component was in operation. When the probability gate did not respond to interrogation (the other half of the occasions) during the VT component, that response to the bad-news box and all subsequent responses within that component produced no image in the image box. In other regards, the program was unchanged from the prior experiment.

In sum, responses to the no-news response box always produced a stimulus that was uncorrelated with the schedule in effect. A response to the bad-news response box: (a) produced an image-box image that was correlated with EXT with $p = .25$ (gray, winding line); (b) produced an image-box image that was uncorrelated with the schedule in effect with $p = .5$ (blank, white image); or (c) produced nothing in the image box with $p = .25$. This lack of stimulus change was, of course, correlated with ''good news.''

The script was altered to reflect this change. The changed text is presented below in bold font.

> In this experiment you have the chance to occasionally earn a point which is worth a nickel. The number of nickels earned will be shown in the following box (experimenter points to reinforcer counter on screen). The sum earned will be paid at the end of today's session. Also on the screen are two keys to which you can respond (experimenter points to keys). One key (left or right, depending upon the participant), when pressed by a mouse click, will present a stimulus pattern. This pattern means either that a nickel is coming soon or that a nickel is not coming soon. **The other key will sometimes produce a white color or a differently colored stimulus pattern. One of these—the white color or the differently colored stimulus pattern—means only that a nickel is not coming soon. The other means that a nickel is coming soon or is not coming soon.**
>
> The keys you press will have no effect upon your earnings. In fact, your earnings will be the same even if you do not respond to either key. While the money you earn is not dependent on responding, you are nevertheless asked to respond at a rate of approximately twenty responses per minute (experimenter simulates this rate with the mouse).
>
> So, responses to one key will tell you a nickel is coming soon or not coming soon. **Responses to the other key will sometimes tell you that a nickel is not coming soon.**
>
> Do you have any questions?

Table 5

For each participant in each session of Experiment 5: responses to the no-news (row 1) and bad-news (row 2) responses boxes. Relative no-news response rate is presented for each subject and the mean (M) across subjects at the bottom of each session's raw-data array.

Session 1:	Participant 19	Participant 20	Participant 21	Participant 22	Participant 23	Participant 24	Participant 25
1. no-news responses	364	lost	1541	132	45	161	572
2. bad-news responses	322	data	486	154	38	262	601
No-news choice proportion:	.53		.76	.46	.54	.38	.49 (M = .53)
Session 2:	**Participant 19**	**Participant 20**	**Participant 21**	**Participant 22**	**Participant 23**	**Participant 24**	**Participant 25**
1. no-news responses	682	353	1566	134	28	135	346
2. bad-news responses	462	586	958	164	45	155	360
No-news choice proportion:	.6	.38	.62	.45	.38	.47	.49 (M = .48)

Note. Due to experimenter error, Participant 20's first-session performances were lost.

Response-box types were counterbalanced in terms of position, but stimulus designations were not. In other regards, the procedure was identical to that in the prior experiment.

Results and Discussion

Table 5 presents the results from Experiment 5. As is apparent from second-session data in the table, 5 of 7 participants preferred the bad-news response box to the no-news response box, although in a few cases these preferences were modest. In fact, the mean preference over the 7 participants was just .52 for the bad-news option. Thus, as expected, preference was intermediate to that obtained in Experiments 2 and 3 (clear preference for no news with no implicit good news from the bad-news option) and Experiment 4 (clear preference for bad news with strongly implicit good news from the bad-news option). Comparing the choice proportions from the participants of Experiment 3 (mean preference for no-news of .66) with those from the participants of Experiment 5 (mean preference of .48 for no-news) we find $t(10) = 1.68$, $p = .06$. Comparing the choice proportions from the participants of Experiment 4 (mean preference of .13 for no-news) with those from the participants of Experiment 5 (mean preference of .48 for no-news) we find $t(10) = 4.81$, $p = .0004$.

GENERAL DISCUSSION

Figure 1 summarizes the results of this study's five experiments. Experiment 1 replicated the oft-found result that good news is preferred to bad news. In Experiment 2 no news was preferred to bad news, a result also consistent with the preponderance of the prior literature (but see our discussion below). A perhaps puzzling aspect of the results of Experiment 2 was the fact that preference for no news (over bad news) was about as robust as that for good news over bad news in Experiment 1. One possibility simply involves the variability inherent in between-subject comparisons (across the two experiments). Another possibility involves sensory reinforcement that was available at a greater rate for no news in Experiment 2. Sensory reinforcement can also account for the fact that any responding occurred on the bad-news option.

While participants preferred occasional good news or no news to occasional bad news (Experiments 1 through 3), they also preferred occasional bad news when a cue for good news was reliably associated with the absence of stimulus change following a response to the bad-news option (Experiment 4). When this association was weakened, results were intermediate (Experiment 5).

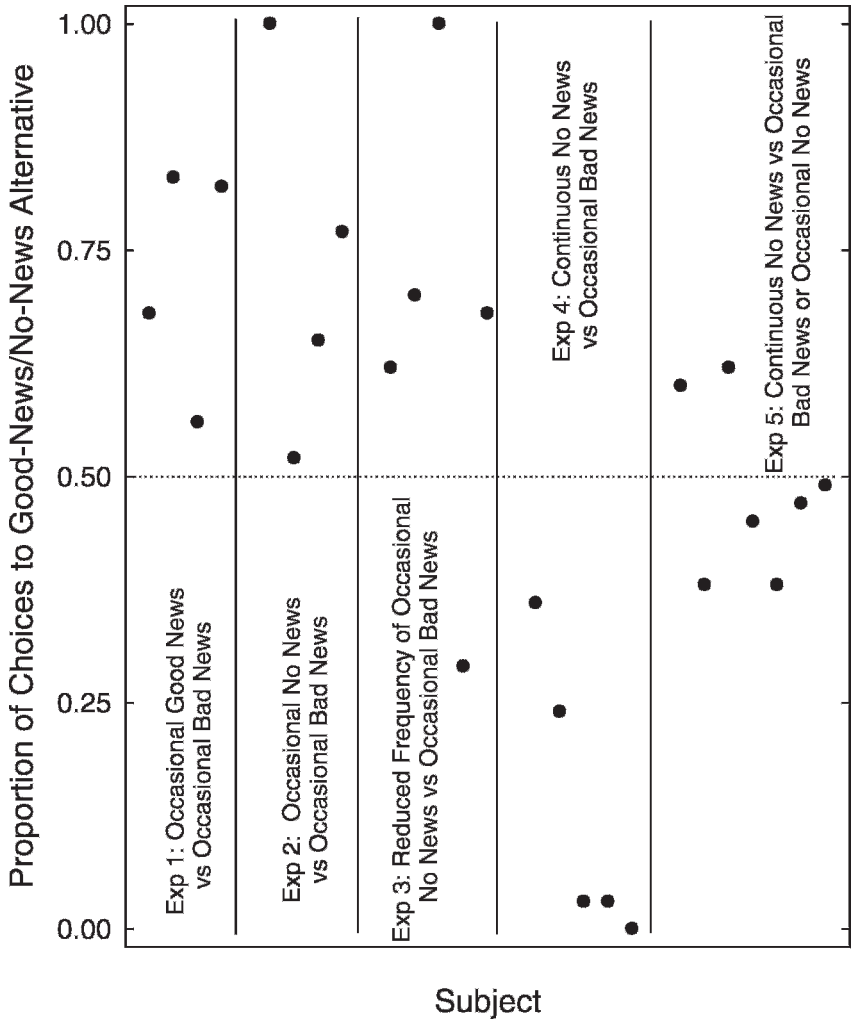

Fig. 1. The relative frequency with which each participant chose either the good-news or no-news response box in each of the five experiments. Each experiment's data set is arrayed from left to right with successive experiments separated by a vertical line. A dotted horizontal line distinguishes between preference for good news or no news (above dotted line) vs bad news (below dotted line).

But this conclusion should not be unsettling to proponents of the information view. Optimal use of information generally dictates that bad news not be reinforcing if it has no utility. Case et al. (1985), Case, Ploog, and Fantino (1990), and Fantino and Case (1983) also argued for the critical role of utility. When production of ''bad news'' is correlated with the opportunity to rest during an effortful task (e.g., Case et al., 1985; Perone & Baron, 1980) or to engage in another activity (e.g., Case et al., 1990), then the bad news is useful, or more technically, is also a discriminative stimulus for reinforcement. For example, participants in Case et al. (1990) played a version of a Star Trek game in which the reinforcers were Klingons that could be shot. The ''bad news'' stimulus indicated that no Klingons were available. When this news could not be utilized in the game context, no news was preferred to bad news. However, when participants could use the time provided by the bad news to refuel (and therefore improve their prospects later) bad news was preferred to no news.

Perone and Kaminski (1992) reported results suggesting that the S- may reinforce observing. Their subjects preferred bad news over no news when the instructions did not specify that the S- was correlated with extinction (their Experiment 3). When the instructions were more explicit, as in the UCSD studies, the more common result of preference for no news over bad news was obtained (Perone and Kaminski, Experiments 1 and 2). Escobar and Bruner (2009) have interpreted the Perone and Kaminski finding of preference for the S- as follows: ''Furthermore, the fact that the S- reinforced observing only when the contingencies operating in the observing procedure were not described to the subjects suggests that an accidental relation between the S- and the reinforcer may have been established'' (p. 216).

The present results and their interpretation are consistent with the conditioned-reinforcement hypothesis as well as with an interpretation of Lieberman et al.'s (1997) results in terms of that hypothesis. Lieberman et al. concluded: ''We suggest that humans do find information reinforcing, but that this preference depends on the utility of the information'' (p. 20). Phrased in this manner, there would appear to be no difference between Lieberman's interpretation and our own. Indeed, we can regard Lieberman's hypothesis as a *weak* form of the information hypothesis where good news is broadly conceived to include anything useful, and—critically—useless information is not considered reinforcing. Since a stimulus correlated with ''anything useful'' should function as a conditioned reinforcer, and since the conditioned-reinforcement hypothesis has always specified that useless information should not maintain observing, the two views are identical. However, the traditional distinction between the information and conditioned-reinforcement hypotheses (e.g., Bloomfield, 1972; Fantino & Case, 1983) has rested on the question of whether or not a stimulus correlated with the *absence* of reinforcement would maintain observing (and thus serve as a conditioned reinforcer). We might consider this traditional view the *strong* version of the information hypothesis. The difference between this strong, traditional view of the information hypothesis and the conditioned-reinforcement hypothesis of observing rests on whether useless information should be rewarding. We submit that the negative answer proposed by the conditioned-reinforcement hypothesis, and supported by the empirical work on this issue, including the present results and those of Lieberman et al. (1997), is well in keeping with the notion of a rational, efficient information processor.

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